

FURTHER NOTES ON THE OVIPARITY OF
THE LARGER VICTORIAN *PERIPATUS*, GENERALLY
KNOWN AS *P. LEUCKARTII*.

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(Communicated by Professor W. A. Haswell.)

My observations* on the oviparous habit of the larger Victorian *Peripatus* (hitherto generally regarded as identical with the *Peripatus leuckartii* of Säng.) have excited a good deal of hostile criticism, chiefly emanating from the pen of Mr. J. J. Fletcher. On three different occasions since the publication of my notes Mr. Fletcher has brought the question before the Linnean Society of New South Wales, and his remarks have been published (I do not know whether in full or not) in the Abstracts of Proceedings of the Society.†

I have already replied to the earlier criticisms in a short paper read at the Hobart Meeting of the Australasian Association for the Advancement of Science, which will, I am informed, be published shortly. Mr. Fletcher's latest observations, however, compel me to return to the question, and I am the more willing to do so as I have some further information to communicate in support of my views.

The object of Mr. Fletcher's latest contribution to the literature of the subject is explained in the opening paragraph, which runs as follows:—"This paper is a reply to certain views expressed by Dr. Dendy with regard to the reproduction of the New South

* Proc. Roy. Soc. Victoria for 1891, p. 31; "Nature," September 17, 1891; and "Zoologischer Anzeiger," No. 380, 1891.

† September 30, 1891; February 24, 1892; April 27, 1892.

Wales *Peripatus*, which on the *ipse dixit* of Dr. Dendy himself is *P. leuckartii*, Säng. ; the questions at issue being not whether or no the Victorian *Peripatus* is oviparous, but whether, firstly, Dr. Dendy was justified, on the evidence before him and in the absence of any personal knowledge of the reproduction of the N.S.W. *Peripatus*, in contradicting statements which were quite in order ; and secondly, as Dr. Dendy's views were published in September, 1891, and as certain information on the subject was subsequently brought under his notice, whether it is not now nearly time that Dr. Dendy took steps to explain that his views apply wholly and solely to the Victorian *Peripatus*, and to withdraw his insinuations respecting, and his erroneous interpretation of, 'Mr. Fletcher's observations,' because already Dr. Dendy's statements are finding their way into the records of zoological literature, and confusion and misapprehension may result therefrom."

In reply to Mr. Fletcher's indictment I wish to make the following remarks :—

(1) I do not understand the meaning of the statement that the New South Wales *Peripatus* is, "on the *ipse dixit* of Dr. Dendy himself," *P. leuckartii*. I certainly am not responsible for this identification, which was, I believe, first made by Mr. Olliff, who remarks,* on first recording the animal from New South Wales, that "The species is identical with that recently recorded by Mr. Fletcher from Gippsland, and is probably the *Peripatus leuckartii* of Sänger." I need scarcely point out that the name *leuckartii* has since been applied by Mr. Fletcher himself to the New South Wales species.

Possibly Mr. Fletcher means to refer to the larger Victorian species, of which the first recorded specimen was identified by himself † as "in all probability an example of *P. leuckartii*, Sänger." If Mr. Fletcher will refer to my earliest communication on the subject, ‡ he will find that in recording the discovery of

* P.L.S.N.S.W. Vol. ii. p. 981.

† P.L.S.N.S.W. Vol. ii. p. 450.

‡ "Victorian Naturalist," January, 1889.

two specimens at Warburton (only one specimen having been previously recorded from this colony) I made the following statement: "After carefully studying Professor Sedgwick's full description of *P. leuckartii*, I am fairly certain that they do not belong to that species, but to a new one, which I for the present refrain from naming"—basing my conclusion on the remarkable pattern of the skin. Professor Sedgwick, however, in reply to my observations, expressed the opinion* that the species probably was subject to a considerable range of variation in colour. Having studied more specimens, I myself came to the same conclusion,† and have since then followed Mr. Fletcher in calling the larger Victorian species *P. leuckartii*. This use of the name *leuckartii* on my part seems to be Mr. Fletcher's chief grievance against me, but I would ask him to remember that I have only followed his own lead in this respect.

(2) I am not aware that I have contradicted any statements, for the simple reason that I cannot find that there were any definite statements as to the mode of reproduction of the New South Wales *Peripatus* for me to contradict. There was merely the assumption by Mr. Fletcher (which I quoted and characterised as very natural) that the young animals which he found in company with the parent had been born alive.

(3) I consider that I was fully justified in assuming that the mode of reproduction of the N.S.W. *Peripatus* was the same as that of the Victorian one, as at the time when I wrote there were no definite observations published as to the mode of reproduction of the former, and it was almost inconceivable that different individuals, which Mr. Fletcher himself, in common with all other writers on the subject, regarded as belonging to one and the same species, should be oviparous in the one colony and viviparous in the other. I have no doubt now that the New South Wales *Peripatus* is viviparous, as maintained by Mr.

* "Nature," February 28th, 1889.

† "Observations on the Australian Species of *Peripatus*." Proc. Roy. Soc. Victoria, July 11th, 1889.

Fletcher and Professor Haswell, but I would ask Mr. Fletcher to remember that when I wrote the only published observations as to the mode of reproduction of the New South Wales species were (a) the finding of the young in company with the mother, though there was nothing, so far as the published account goes, to show that they had not been hatched from eggs laid for some time, and (b) a footnote* to one of Mr. Fletcher's observations, stating that a female had been dissected and found to be pregnant; the term pregnant is not defined, and might, in my opinion, be correctly applied to a female containing large but undeveloped eggs in the uterus; nothing is said by Mr. Fletcher about the embryos.

Mr. Fletcher may personally have had abundant evidence that the New South Wales *Peripatus* was viviparous, but that evidence was not published, and not known to me when I wrote, and therefore I consider that I was quite justified in stating that the mode of reproduction of *P. leuckartii* was unknown, and in placing my own interpretation upon the only recorded facts as to the life-history of the New South Wales form. Naturally, I interpreted them in the light of my own observations on the Victorian species. That interpretation I now fully admit to be incorrect, and I congratulate myself that if my observations have had no other good result they have at least elicited some definite information as to the mode of reproduction of the New South Wales *Peripatus*.

(4) Mr. Fletcher seems to be very greatly troubled because my statements are already "finding their way into the records of zoological literature, and confusion and misapprehension may result therefrom." There is not the slightest need for confusion now that we have at length a definite statement as to the reproduction of the N.S.W. species. It must be perfectly obvious to every reader that my own observations were based entirely on Victorian specimens, as stated distinctly in the paper, and that my suggestion as to the New South Wales form was a perfectly

* P.L.S.N.S.W. Vol. iii. p. 892.

justifiable, though, as it turns out, incorrect, deduction from the only published facts. It is perhaps unfortunate that both the New South Wales and Victorian forms should have been included under the name *leuckartii*; but for this Mr. Fletcher himself is at least as much responsible as any one.

(5) Mr. Fletcher states that the question at issue is not whether or no the Victorian species is oviparous. Herein I must beg to differ from him, as this is the real question which I have been all along trying to solve, and compared with which the mere question of nomenclature is, in my opinion, insignificant. In concluding his observations he also indulges in certain offensive and unjustifiable personalities, which I need not quote. It is greatly to be regretted that he should have considered such a proceeding advisable, and, for my own part, I entirely fail to see the advantage to be derived therefrom and must refuse to follow his example in this respect.

Probably the solution of the whole difficulty will be found to lie in the fact that my original opinion was correct after all, and that our larger Victorian *Peripatus* is specifically distinct from *P. leuckartii*. For the present, however, I still refrain from giving it a distinctive name, as I have had very few specimens from other localities to compare it with, and do not wish, if it can be helped, to create a new species merely on account of the oviparous habit. This question, however, is discussed in my communication to the Australasian Association already referred to.

As to the oviparous habit of our larger Victorian species (so called to distinguish it from the smaller *P. insignis*) I have some additional evidence to offer, and I would like at the same time to recapitulate the main arguments in favour of my view. My critics have entirely ignored all that is new in my observations, such as the remarkable sculptured egg-shell, and have suggested that what I have observed is simply a case of abnormal extrusion of eggs such as takes place sometimes in *P. novæ-zealandiæ*. Professor Hutton, however, who made the observation on the New Zealand species, merely states that the eggs are often

extruded before development is complete and then always die. Professor Sedgwick quotes these statements in his Monograph of the genus, and yet in replying* to my letter in "Nature" he states that "no one knows whether the eggs so extruded undergo complete development"! I suppose that most animals sometimes extrude eggs which never complete their development, but this has really little to do with the question. What I have been endeavouring to prove is that the larger Victorian species of *Peripatus* is normally oviparous. The two principal arguments originally brought forward—both of which have been entirely overlooked by my critics—were (1) that female specimens dissected at various times of the year were never found with embryos in the uterus, as has been so frequently described for other species, but generally with large undeveloped eggs of definite oval shape and with a thick membrane; (2) that the shell or membrane of the eggs after (but not before) being laid is very definitely and characteristically sculptured on the outer surface, in such a manner as to recall the eggs of many insects. This sculpturing alone appears to me to indicate a truly oviparous habit, and, inasmuch as it affords another character common to *Peripatus* and the *Insecta*, to deserve special attention. I am not aware that a sculptured egg-shell has hitherto been observed in *Peripatus*, and I should be glad to learn from Mr. Fletcher whether anything of the kind has ever been found around embryos of the New South Wales species which have, as he informs us,* been extruded in the process of drowning.

The additional evidence on the subject which I now wish to bring forward consists in the subsequent history of the fourteen eggs which were laid in my vivarium between the 18th May and the 31st July last year, and of one which, though possibly laid about the same time, was not discovered until September 16. Before going any further, however, I may premise that the fact that the eggs are really those of *Peripatus* has been absolutely

* "Nature," September 24th, 1891.

* P.L.S.N.S.W. September 30, 1891.

proved by their development. It may also be as well to relate the fate of the parent animals by which the eggs were laid.

It may be remembered that on the 31st July, 1891, when the eggs were first found, there were in the vivarium three females and one male, all apparently in good health. The male specimen died shortly afterwards, but on August 17th the females were still all alive and apparently healthy. On August 31st, as mentioned in a postscript to my first communication on the subject, one of the female specimens was found dead. On being dissected the reproductive organs appeared very well developed, but, although the ovary and oviducts were both large (the former containing a great many ovarian eggs), there was not a single egg in either of the oviducts, all having been doubtless laid.

On September 16th the two remaining females were still alive. I killed and dissected one. The organs appeared healthy and well developed. In the lower part of each oviduct one large egg was found. The eggs presented the usual characters, having a very thick but unsculptured envelope filled with yolk. Both eggs were cut open and examined microscopically, but I did not succeed in recognising any trace of an embryo in either.

On completely turning out the vivarium and examining its contents carefully I found one more *Peripatus* egg amongst the rotten wood (September 16th). It looked much healthier than those which had previously been transferred from the vivarium, many of the latter having already begun to shrivel up and acquire a dark colour. In the newly found egg, and also in the healthier looking of those previously obtained, there now appeared to be a dark spot in the interior, but this was only dimly visible through the thick sculptured shell.

On September 25th the last remaining female was still apparently in good health, but on October 1st it was found dead—how long it had been so I do not know. On dissection I found the internal organs in a bad condition. Neither eggs nor embryos were visible in the oviducts. The ducts of the slime glands were

very much enlarged and swollen out, while the branched portions appeared feebly developed, in fact not distinctly recognisable. The alimentary canal was almost empty, and the animal seemed to have died of starvation.

On October 3rd I dissected one of the eggs from the hatching-box. I could find no embryo in it, but only the same semi-liquid, yolk-like contents as when *in utero*, full of little oil or yolk globules. Inside the thick sculptured "shell" there was, as usual, a very thin and delicate transparent membrane. Probably a young embryo was really present but was broken up in opening the egg and overlooked; even at a much later period the embryonic tissues are extremely delicate.

On November 30th I noted that several of the eggs were showing indications of an embryo appearing coiled up within them, but the shell was so thick and opaque that it was impossible to make out any details. I dissected the egg which was found on September 16th, and which had since then been kept separate from the rest. I found in it a beautiful embryo *Peripatus* in an advanced stage of development. The embryo was surrounded by a delicate transparent membrane, which fitted closely on to it and was very difficult to remove; outside this came the sculptured shell. The embryo possessed a distinct head, with clearly recognisable brain, eyes and ringed antennæ, and there were at least seven pairs of appendages behind the antennæ. It lay tightly coiled up, with the posterior extremity resting against the side of the neck, in such a position as to make it very difficult to count the appendages. The specimen was stained and mounted in Canada balsam.

This embryo, then, developed for more than 10 weeks after the egg had been laid and did not show the least sign of "going to the bad."

I need hardly say that during the heat of the summer months I found it a very difficult matter to keep the eggs in a suitable condition of moisture, especially as I had no previous experience to guide me. Hence it is not to be wondered at that the majority of the eggs perished, shrivelling up and being attacked by a mould.

As I was away from Melbourne for some weeks during the summer, I entrusted the eggs to the care of the Rev. W. Fielder, who most kindly looked after them for me in my absence. Frequent attention was necessary in renewing the supply of moisture.

On April 14th, 1892, only three eggs remained in the hatching box, the others having been removed as they showed signs of going bad. One of the remaining three had been showing dark pigment inside for some days past. This egg I removed and carefully dissected. I found the shell of a much darker (yellow) colour than when laid, a good deal crumpled on the surface, and very soft, as though beginning to decay away. The contained embryo was removed and found to be in excellent condition, although *outside* it there appeared under the microscope a great many very fine threads, which I take to be the hyphæ of a fungus. Possibly this fungus might have ultimately killed the embryo, but the latter was so far advanced that it seemed to be on the verge of hatching. It was enclosed within the usual transparent delicate membrane lying within the thick shell. I could not determine whether the fungal hyphæ had penetrated within this inner membrane, but I think it very doubtful. The embryo was tightly coiled up as in the previous case. When uncoiled it measured about 5 mm. in length (exclusive of the antennæ) and 1 mm. in breadth. *All* the appendages were developed, viz., antennæ, oral papillæ, two pairs of jaws and fifteen pairs of claw-bearing legs. The eyes were conspicuous at the bases of the antennæ, and the antennæ themselves showed each about twenty deeply pigmented annuli. The remainder of the body was nearly white, but very distinct isolated pigment patches (chiefly indigo-blue, with a few specks of orange) appeared scattered pretty abundantly over the legs and back. The mouth was surrounded by the very characteristic, thick, transversely furrowed lip. The dermal papillæ were very obvious and exhibited the characteristic spines, the cuticle being very strongly developed. The claws on the feet were very distinct. The alimentary canal was full of granular food yolk. The specimen was stained with borax carmine and mounted in Canada balsam.

This embryo, then, developed for at least eight months and a half after the egg was laid, and at the end of that time was a perfect young *Peripatus*, differing externally from the adult only in its smaller size and less deeply pigmented skin.

There are still two eggs left in the hatching box, but they do not look to me at present as if they were going to hatch. Whether they do so or not, however, I think I may fairly claim to have now definitely proved that the larger Victorian *Peripatus* at any rate sometimes lays eggs, and that these eggs are capable of undergoing development outside the body until perfect young animals are produced. The great length of time required for the development of the eggs is very remarkable, but is only what one might expect on considering the unusual length of time required for intra-uterine development in other species.